Project No.	**Project Title**	
2021-01-013	Insect collecting robot	
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Abstract

Insects are a major problem in agriculture causing 10% to 16% of annual loss in crop production. The rise of global warming increases this number by 19% to 31%. Ecological monitoring enables early detection of insects and helps understand the influence of different variables on the ecosystem.

This project is part of a wider research aiming to develop an autonomic monitoring robot that detects insects on nectarine trees in an orchard. This research focuses on directing a manipulator towards branches and taping them to collect insects into a collector and count them. To do so, two image processing algorithms were developed. The major analysis in the first algorithm was conducted by color space analysis while the method in the second algorithm focused on texture and structural analysis. The first algorithm is based on adaptive thresholding. The algorithm learns the tree's skeleton pixel values over a set of different images. The selected threshold values are chosen by the best accuracy. Finally, the Hough transform is applied. For the second method, Otsu's method was applied for removing the background. Then, the Gabor method for features extraction is performed. SVM is implemented as a classifier.

A dataset of 120 images of 10 young nectarine trees was created by acquiring RGB-D images, at three different times along the day to create a variety of conditions (4 photos per plant each time). Out of 120 images, 15 random images were selected (5 from each hour of the day). Each image was manually tagged with approximately 3 trees skeleton. The dataset was divided into 70% train dataset and 30% test dataset. From the 70% training dataset, 20% were taken for validation using Greed search for cross-validation. Accuracy and false detection results will be presented.

Additionally, a 6 DOF robot manipulator was programmed for specific branches which in the future will be based on these detections. A simulation model was developed, and time analysis was performed to reveal best operational parameters.

Keywords: Insects, Precision Agriculture, Ecological Monitoring Robot, Skeleton Identification, Image Processing.